

What is Claimed:

1 A method for processing a plurality of sequentially encoded and
2 channel impaired sample values, the samples being encoded according to a
3 predetermined set of code values, the method comprising the steps of:

4 dividing the set of code values into a plurality of subsets, each subset
5 including a plurality of values; and

6 partially decoding and quantizing each sample value of the successive
7 sample values to assign the sample value to one of the subsets, wherein the partial
8 decoding of each sample value is based on a current sample value of the successive
9 sample values and on a previously decoded sample value of the successive sample
10 values.

1 2. A method according to claim 1, wherein the sequential sample
2 values are trellis encoded and the step of partially decoding and quantizing each sample
3 value includes the step of calculating path metrics for the current sample value
4 responsive to the path metrics calculated for the previously decoded sample value.

1 3. A method according to claim 1, wherein the sequential sample
2 values are trellis encoded and the step of partially decoding and quantizing each sample
3 value includes the step of calculating path metrics for the current sample value and using
4 the calculated path metrics to calculate a most likely path metric of the current sample
5 value.

1 4. A method according to claim 3, wherein the trellis code defines a
2 state-transition diagram in which a change from the previous sample value to the current
3 sample value represents a transition in the state transition diagram and every state in the
4 state transition diagram is associated with a path metric, and the step of calculating the
5 most likely path metric for a specific state for the next sequential sample value includes
6 the step of selecting a most likely transition in the state transition diagram from any state

7 corresponding to the previous sample value to a specific state of the current sample
8 value.

1 5. A method according to claim 3 wherein the trellis encoded set
2 corresponds to a set-partitioned code.

1 6. A method according to claim 3, wherein the trellis encoded set of
2 code values is a set-partitioned code encoded that uses feedback convolution codes.

1 7. A decoder and quantizer that may be used to recover N-bit
2 symbols, where N is an integer greater than two, from successive channel impaired input
3 samples representing a signal encoded according to a trellis code, wherein the trellis
4 code defines a constellation, the decoder and quantizer comprising:

5 a plurality of decision devices, each decision device corresponding to a
6 subset of the constellation defined for the trellis code;

7 a partial trellis decoder that generates an estimate of the subset to which a
8 current symbol belongs based on the current sample and on a previously decoded
9 symbol and, responsive to the estimate, selects one decision device of the plurality of
10 decision device to generate the estimate of the N bits.

1 8. A decoder and quantizer according to claim 7, wherein the trellis
2 code is a set partitioned code using feedback convolutional encoding and the partial
3 trellis decoder computes path metrics for a current symbol based on previously
4 computed path metrics of a previous symbol and determines a best path metric from
5 among all path metrics computed for the previous symbol to select the one decision
6 device.

1 9. A decoder and quantizer according to claim 7, wherein the trellis
2 code is a set-partitioned code which defines a state-transition diagram and the partial
3 trellis decoder computes path metrics for the current symbol based on previously
4 calculated path metrics of the previous symbol and determines a best path from path

5 metrics computed for the current symbol, corresponding to a subset of the states for the
6 previous symbol, to select the one decision device.

1 10. A decoder and quantizer according to claim 9, further including a
2 classifier for identifying ones of the path metrics computed for the previous symbol as
3 better path metrics than other ones of the path metrics computed for the previous
4 symbol, wherein the subset of states selected for the previous symbol are states
5 corresponding to the identified better path metrics.

1 11. A decoder according to claim 10, wherein each path metric
2 includes a measure of Euclidean distance.

1 12. An equalizer for a digital demodulator that demodulates a trellis
2 coded signal having channel impaired symbols that have been digitally coded according
3 to a constellation and then modulated onto a carrier wave, the equalizer comprising:

4 a finite impulse response (FIR) filter coupled to receive the trellis coded
5 signal as a passband signal and to provide a first filtered output signal;

6 an infinite impulse response (IIR) filter, including a summing circuit
7 having a first input port coupled to receive the first filtered output signal and an output
8 port coupled to an IIR filter element, the IIR filter element being coupled to provide an
9 output signal to a second input port of the summing circuit, the IIR filter providing a
10 second filtered output signal at the output port of the summing circuit; and

11 a slicer that is selectively coupled between the output port of the summing
12 circuit and the IIR filter element, the slicer including:

13 a plurality of decision devices, each decision device corresponding
14 to a subset of the constellation defined for the trellis code;

15 a partial trellis decoder that generates an estimate of the subset to
16 which a current channel impaired symbol belongs based on the current sample
17 and on a previously decoded channel impaired symbol and, responsive to the

18 estimate, selects one decision device of the plurality of decision devices to
19 generate the estimate of the current channel impaired symbol.

1 13. An equalizer according to claim 12, wherein both the FIR filter and
2 the IIR filter process passband signals to provide a passband signal as the second filtered
3 signal.

1 14. An equalizer according to claim 13, further comprising:

2 a first mixer coupled to the output port of the summing circuit and coupled
3 to receive an estimated residual carrier signal, for demodulating the output signal of the
4 summing circuit to provide a baseband signal as an input signal to the slicer;

5 a second mixer coupled to the slicer and coupled to receive a further
6 estimated residual carrier signal for remodulating the output signal of the slicer to
7 provide a passband signal to the IIR filter element; and

8 carrier loop circuitry, coupled to receive the input signal to the slicer and
9 the output signal of the slicer, and to provide the estimated residual carrier signal and the
10 further estimated residual carrier signal to the first and second mixers.

1 15. An equalizer according to claim 12, wherein the first filtered signal
2 provided by the FIR filter is a passband signal and the equalizer further comprises a
3 mixer coupled between the FIR filter and the IIR filter and coupled to receive an
4 estimated residual carrier signal to transform the first filtered signal into a baseband
5 signal, and the IIR filter is configured to process the baseband signal to produce a
6 further baseband signal as the second filtered signal; and

7 the equalizer further includes carrier loop circuitry, coupled to receive
8 respective input signals from the output port of the summing circuit and the output port
9 of the slicer and to provide the estimated residual carrier signal to the mixer.

1 16. An equalizer according to claim 12, wherein the constellation
2 defines a code set that is a set partitioned code using feedback convolutional encoding

3 and the partial trellis decoder computes path metrics for a current symbol based on
4 previously computed path metrics of a previous symbol and determines a best path
5 metric from among all path metrics computed for the previous symbol to select the one
6 decision device.

1 17. An equalizer according to claim 12, wherein the trellis code is a
2 set-partitioned code that defines a state-transition diagram and the partial trellis decoder
3 computes path metrics for the current symbol based on previously calculated path
4 metrics of the previous symbol and determines a best path from path metrics computed
5 for the current symbol, corresponding to a subset of the states for the previous symbol,
6 to select the one decision device.

1 18. An equalizer according to claim 17, further including a classifier
2 for identifying ones of the path metrics computed for the previous symbol as better path
3 metrics than other ones of the path metrics computed for the previous symbol, wherein
4 the subset of states selected for the previous symbol are states corresponding to the
5 identified better path metrics.

1 19. A decoder according to claim 18, wherein each path metric
2 includes a measure of Euclidean distance.

1 20. A decoder according to claim 12, wherein the plurality of decision
2 devices consists of four decision devices, each decision device corresponding to two
3 respective elements of the constellation defined by the trellis code.

1 21. An equalizer according to claim 12, wherein the trellis code is
2 compliant with a standard for digital television terrestrial broadcast adopted by the
3 Advanced Television Systems Committee (ATSC).

1 22. An equalizer for a digital demodulator that demodulates a trellis
2 coded signal having channel impaired symbols that have been digitally coded according
3 to a constellation and then modulated onto a carrier wave, the equalizer comprising:

4 a finite impulse response (FIR) filter coupled to receive a the trellis coded
5 signal as a baseband signal and to provide a first filtered output signal;

6 an infinite impulse response (IIR) filter, including a summing circuit
7 having a first input port coupled to receive the first filtered output signal and an output
8 port coupled to an IIR filter element, the IIR filter element being coupled to provide an
9 output signal to a second input port of the summing circuit, the IIR filter providing a
10 second filtered output signal at the output port of the summing circuit; and

11 a slicer that is selectively coupled between the output port of the summing
12 circuit and the IIR filter element, the slicer including:

13 a plurality of decision devices, each decision device corresponding
14 to a subset of the constellation defined for the trellis code;

15 a partial trellis decoder that generates an estimate of the subset to
16 which a current channel impaired symbol belongs based on the current sample
17 and on a previously decoded channel impaired symbol and, responsive to the
18 estimate, selects one decision device of the plurality of decision devices to
19 generate the estimate of the current channel impaired symbol.

1 23. An equalizer for a digital demodulator that demodulates a trellis
2 coded signal having channel impaired symbols that have been digitally coded according
3 to a constellation and then modulated onto a carrier wave, the equalizer comprising:

4 a finite impulse response (FIR) filter coupled to receive a the trellis coded
5 signal as a passband signal and to provide a first filtered output signal;

6 an infinite impulse response (IIR) filter, including a summing circuit
7 having a first input port coupled to receive the first filtered output signal and an output
8 port coupled to an IIR filter element, the IIR filter element being coupled to provide an
9 output signal to a second input port of the summing circuit, the IIR filter providing a
10 second filtered output signal at the output port of the summing circuit; and

11 a slicer that is selectively coupled between the output port of the summing
12 circuit and the IIR filter element, the slicer including:

13 a plurality of decision devices, each decision device corresponding
14 to a subset of the constellation defined for the trellis code;

15 a partial trellis decoder that generates an estimate of the subset to
16 which a current channel impaired symbol belongs based on a previously decoded
17 channel impaired symbol and, responsive to the estimate, selects one decision
18 device of the plurality of decision devices to generate the estimate of the current
19 channel impaired symbol.

1 24. An equalizer according to claim 23, wherein both the FIR filter and
2 the IIR filter process passband signals to provide a passband signal as the second filtered
3 signal.

1 25. An equalizer according to claim 23, further comprising:

2 a first mixer coupled to the output port of the summing circuit and coupled
3 to receive an estimated residual carrier signal, for demodulating the output signal of the
4 summing circuit to provide a baseband signal as an input signal to the slicer;

5 a second mixer coupled to the slicer and coupled to receive a further
6 estimated residual carrier signal for remodulating the output signal of the slicer to
7 provide a passband signal to the IIR filter element; and

8 carrier loop circuitry, coupled to receive the input signal to the slicer and
9 the output signal of the slicer, and to provide the estimated residual carrier signal and the
10 further estimated residual carrier signal to the first and second mixers.

1 26. An equalizer according to claim 23, wherein the first filtered signal
2 provided by the FIR filter is a passband signal and the equalizer further comprises a
3 mixer coupled between the FIR filter and the IIR filter and coupled to receive an
4 estimated residual carrier signal to transform the first filtered signal into a baseband

5 signal, and the IIR filter is configured to process the baseband signal to produce a
6 further baseband signal as the second filtered signal; and

7 the equalizer further includes carrier loop circuitry, coupled to receive
8 respective input signals from the output port of the summing circuit and the output port
9 of the slicer and to provide the estimated residual carrier signal to the mixer.

1 27. An equalizer according to claim 23, wherein the constellation
2 defines a code set that is a set partitioned code using feedback convolutional encoding
3 and the partial trellis decoder computes path metrics for a current symbol based on
4 previously computed path metrics of a previous symbol and determines a best path
5 metric from among all path metrics computed for the previous symbol to select the one
6 decision device.

1 28. An equalizer according to claim 23, wherein the trellis code is a
2 set-partitioned code that defines a state-transition diagram and the partial trellis decoder
3 computes path metrics for the current symbol based on previously calculated path
4 metrics of the previous symbol and determines a best path from path metrics computed
5 for the current symbol, corresponding to a subset of the states for the previous symbol,
6 to select the one decision device.

1 29. An equalizer according to claim 23, further including a classifier
2 for identifying ones of the path metrics computed for the previous symbol as better path
3 metrics than other ones of the path metrics computed for the previous symbol, wherein
4 the subset of states selected for the previous symbol are states corresponding to the
5 identified better path metrics.

1 30. A decoder according to claim 29, wherein each path metric
2 includes a measure of Euclidean distance.

1 31. A decoder according to claim 23, wherein the plurality of decision
2 devices consists of four decision devices, each decision device corresponding to two
3 respective elements of the constellation defined by the trellis code.

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3 32. An equalizer according to claim 23, wherein the trellis code is
compliant with a standard for digital television terrestrial broadcast adopted by the
Advanced Television Systems Committee (ATSC).

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